

**IN-LINE ROLLER SKATE WITH ANTI-LOCK BRAKE**

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**FIELD OF THE INVENTION**

1. The described invention relates to in-line roller skates, which have their wheels in tandem, and more particularly to an anti-lock, one-way braking wheel for such skates.

**BACKGROUND OF THE INVENTION**

2. It is well known by those skilled in the art of skating that the safest, most effective way to stop on skates is to turn to the backward skating direction and lean forward onto a braking device on the front of the skates. For many years this has been accomplished on figure roller skates with a toe stop (a piece of rubber mounted on the front of the boot or frame just above the skating surface) and on figure ice skates with a "pick" on the front of ice skate blades. However, it is also well known by those skilled in the art of designing wheeled vehicles that the most effective braking is accomplished by maintaining rolling contact with the ground surface. This is because the static friction (rolling contact) between most surfaces is up to 35 percent higher than the kinetic friction (skidding contact) between the same two surfaces. Also, if the braking wheel locks and quits turning, the abrasive skating surface will quickly wear a flat spot on the wheel, thus reducing the service life of the wheel.

3. Patents 5,135,244 to Allison, 5,342,071 to Soo, 5,486,011 to Nelson, 5,551,172 to Repucci all share similar principles of operation. These patents utilize the approach

that while skating backward the heel of the boot can be raised putting enough weight on the front wheel to force it up against a brake surface located above it, causing a braking effect directly proportional to the weight applied to the wheel. These prior art front wheel braking devices share a dangerous safety hazard with the common toe stop referred to above. When skating forward on bumpy surfaces, playing a contact sport such as hockey, or coming into contact with other skaters, a skater can be forced up on the front wheel of one or both skates, which could cause inadvertent application of the brakes and potentially topple the skater. This is the primary reason that hockey skates do not have toe stops or picks.

4. Accordingly, the need exists for an in-line roller skate having a front braking wheel that will roll, without skidding, to a rapid stop on most skating surfaces in the backward skating direction when the maximum braking force is applied, but will not function as a brake if accidentally applied in the forward skating direction.

5. Another disadvantage of prior art in-line roller skates is also apparent. Figure skating on in-line roller skates has recently gained some popularity because of its similarity to figure skating on ice skates. Jumps can be performed on in-line skates with much the same ease as on ice skates, however spins are very difficult and cannot be performed with the speed and duration that can be accomplished on ice skates. For many years long duration high speed spins have been performed on conventional roller skates of the type having two wheels mounted in a truck (the steering mechanism) on both the front and rear of the skate. Those skilled in the art of figure skating on these conventional skates can shift their weight up to the front two wheels and over to one side of the skate which, due to the action of the truck, lifts one of the rear wheels slightly off the skating surface. A spin is then accomplished by sliding the other rear wheel around and around the front wheels that are rolling around each other or

pivoting, if both biased. This provides a stable, three-point platform which offers very little resistance to the spinning motion. However, the single wheel on the front of an in-line skate cannot provide the stable, three-point platform necessary for high quality spins. Accordingly, a need exists for an in-line figure skate having the capacity for spinning.

#### **SUMMARY OF THE INVENTION**

6. The present invention provides an in-line roller skate with at least one, preferably smaller, raised braking wheel in front of or in place of the front load-bearing, skating wheel. The braking wheel is preferably smaller than the skating wheels so that it can be raised up in the frame far enough to allow the skate to be tilted forward about ten degrees without applying the brake. This will allow the execution of certain desirable backward skating motions without accidentally applying the brake. By locating the front skating wheel axle just forward of the ball of the foot and the rear wheel axle just behind the heel of the boot in a three in-line skating wheel arrangement, maximum maneuverability and control can be achieved. The braking wheel is preferably slidably mounted in a vertical slotted hole in the skate frame, so that when the skate is tipped forward and weight is applied over the braking wheel, it moves upward in contact with a counter-rotatable (rotating in one direction only) braking device. Thus the braking wheel is mounted intermediate between the braking device and the skating surface such that when the skate is moving in the backward direction, and the braking wheel and the front skating wheel are in contact with the skating surface, the braking device is in sliding contact with the braking wheel at a point approximately vertically above the contact point between the braking wheel and the skating surface.

7. The counter-rotatable braking device is preferably a clutch bearing or similar ratcheting device, which is mounted on a shaft approximately ten degrees rearward from

vertically above the braking wheel in the skate frame. As is known in the art, clutch bearings, sprags, and a variety of other ratcheting devices can be oriented to allow the braking wheel to rotate freely if accidentally applied while skating forward, and still provide the desired braking action in the backward direction. The braking contact surfaces consist of the outer case of the clutch bearing or one of the other ratcheting devices against the outer perimeter of the braking wheel. While skating backward, if the braking wheel is applied the clutch bearings will not rotate, thus transmitting a consistent braking force to the braking wheel, proportional to the weight applied. If the coefficient of friction between the braking wheel and the skating surface is substantially greater than that between the braking wheel and the clutch bearing case, the braking wheel will maintain rolling traction on the skating surface, without sliding, thus providing the desired antilock braking condition. The smooth, hardened steel outer surface of the braking device is much less abrasive and has a substantially lower coefficient of friction against the braking wheel than any safe skating surface. This invention also offers the advantage of allowing the skater, while standing still (not skating in either direction), to incline the skate forward so that the braking wheel is in contact with the skating surface to accomplish rapid starts in the forward skating direction, or for resisting rearward motion of the skater, such as when the skater is pushing against other skaters in a contact sport utilizing in-line skates.

8. A second embodiment of the present invention provides an in-line skate having a pair of front braking wheels on the same rotational axis, spaced slightly apart and operating independently of each other. The remainder of the skate preferably has the same configuration as the first embodiment previously described. A high quality spin could then be achieved by placing most of a skater's weight on the braking wheels and sliding the front skating wheel around and around the braking wheels, one of which is rolling around the other.

9. A third embodiment of the present invention provides an in-line skate having a front braking wheel that is rotatably mounted on the front end of two arms which are pivotally mounted on the rear end on each side of the skate frame. Tabs protruding outward from the bottom of each side of the skate frame hold the arms and the braking wheel upward in or near contact against the braking device. The remainder of the skate preferably has the same configuration as the first embodiment previously described.

10. Broadly, in one aspect, the present invention concerns an in-line roller skate for skating on a skating surface comprising a boot for supporting the foot of a user, a frame comprising either an integral part of the sole of the boot or a separate part secured to the underside of the boot, a plurality of skating wheels rotatably mounted on the frame for rotation in a common plane, at least one counter-rotatable braking device rotatably attached to the frame comprising means to allow rotation of the device in the forward skating direction and to resist rotation in the other direction, and at least one braking wheel rotatably attached to the frame forward of the skating wheels by means for mounting the braking wheel in contact with the braking device at least when the skate is tilted forward.

11. Broadly, in another aspect, the present invention concerns an in-line roller skate for skating on a skating surface comprising a boot for supporting the foot of a user, a frame secured to the boot having a pair of parallel elongated slots in the forward portion of the frame, the slots having approximately vertical axes, a plurality of skating wheels rotatably mounted on the frame rearward of the slot for rotation in a common plane, at least one counter-rotatable braking device rotatably attached to the frame approximately in line with the axes of the slots, the braking device comprising means to allow rotation of the device in one direction and to resist rotation in the other direction, an axle slidably mounted in the slots, and at least one braking

wheel mounted on the axle, such that the braking device and the braking wheel are in a common plane of rotation and the braking wheel contacts the braking device at a point approximately vertically above the contact point between the braking wheel and the skating surface and wherein the braking device is oriented to allow rotation of the braking wheel against the skating surface in the forward skating direction and to resist rotation of the braking wheel against the skating surface in the reverse skating direction.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

12. FIG. 1 is a side view of an in-line skate with an elevated front braking wheel of the first embodiment of the present invention.

13. FIG. 2 is a side view of the front portion of the skate of FIG. 1 showing the skate tipped forward with the front skating wheel and braking wheel both contacting the skating surface, but with most of the weight of the skater bearing on the braking wheel.

14. FIG. 3 is a side view of the braking wheel and the counter-rotatable brake assembly mounted in the front of the frame of the skate of FIG. 1 showing the braking wheel in contact with the skating surface but in the unloaded condition.

15. FIG. 4 is a cross sectional view of the components of FIG. 3 through the center of the braking wheel and braking device in the same condition as FIG. 3.

16. FIG. 5 is a cross sectional view of the front portion of an in-line skate of a second embodiment of the present invention with two elevated brake wheels.

17. FIG. 6 is a side view of an in-line skate with an elevated front braking wheel of a third embodiment of the present invention with the braking wheel mounted on pivoting arm.

18. FIG. 7 is a side view of the braking wheel, guide arms and brake assembly mounted in the front of the frame of the skate in FIG. 6 showing the braking wheel in contact with the skating surface in an unloaded condition.

19. FIG. 8 is a cross sectional view of the components of FIG. 7 through the center of the braking wheel and braking device in the same condition as FIG. 7.

### **DESCRIPTION OF A PREFERRED EMBODIMENT**

20. Referring to FIG. 1, an in-line skate 10 of the first embodiment of the present invention preferably includes a boot 12, a frame 14 mounted to the underside (sole) of the boot 12, skating wheels 16, 18 and 20, rotatably mounted to the frame 14 as is well known in the art, a raised braking wheel 22, and a brake assembly 24. The approximately three skating wheels 16, 18 and 20 may be of different sizes, but are preferably aligned in the same vertical plane, with rotational axes located such that all skating wheels 16, 18 and 20 simultaneously engage the skating surface 26. The braking wheel 22 is preferably of lesser diameter than the skating wheels 16, 18 and 20, and is preferably elevated with respect to the skating wheels 16, 18, and 20 such that when the skate 10 is tilted forward about ten degrees with the front skating wheel 20 maintaining contact with the skating surface 26, the braking wheel 22 will not contact the skating surface 26. This elevation of the braking wheel 22 allows the execution of certain desirable backward skating motions, while minimizing the potential for unintentionally applying the brake and thus reducing the skater's speed. Although on a prior art figure roller skate equipped with a toe stop, a forward inclination of approximately ten degrees or more is required to bring the toe stop in contact with the skating surface, as is known and appreciated in the art, substantial variations in the configuration of the skate of the present invention are possible, including the incorporation of means to allow adjustment of the size of braking wheel 22 and the location of

the braking wheel 22 with respect to the frame 14, thus controlling the amount of forward inclination of the skate 10 required to bring the braking wheel 22 in contact with the skating surface 26.

21. Referring to FIG. 2, the front portion of the skate of FIG. 1 is shown in the braking position with the skate 10 rotated forward on front skating wheel 20 until most of the skater's weight is resting on wheel 22. Wheel 22 is rotatably mounted on shaft 32, which is slidably mounted in elongated holes (slots) 34 on both sides of frame 14. Clutch bearing 28 is rotatably mounted on shoulder bolt 30, which is firmly mounted in frame 14. Clutch bearing 28 is mounted directly over wheel 22 on shaft 30 and, as well known in the art, will rotate freely in only one direction and lock onto the shaft 30 in the other direction. Bearing 28 is oriented on shaft 30 in the direction that allows wheel 22 to roll against the outer surface of bearing 28 freely in the forward skating direction regardless whether the weight of the skater is applied. The outer surface of bearing 28 is preferably a smooth durable surface, such as hardened steel, which has a high coefficient of friction against the surface of wheel 22, but lower than the coefficient between wheel 22 and all clean, dry surfaces 26 that would be considered safe for roller skating. When the skate 10 is in the forward tilted braking position, slot 34 is approximately vertically aligned with bearing 28 and the normal forces on the top and bottom of wheel 22 and shaft 32 are equal. Therefore, when braking pressure is applied, braking wheel 22 will slide upwardly against high frictional resistance from bearing 28, but continue to rotate without locking up on all safe skating surfaces. As the skater's weight is placed on wheel 22, when skate 10 is tilted forward, the upper perimeter of wheel 22 starts to deform around the steel outer surface of bearing 28, which provides an adequate braking surface for smooth controlled stops.



22. Although, as illustrated in the preferred embodiment, slot 34 has a rearward inclination of approximately ten degrees such that it is oriented approximately vertically when skate 10 is inclined forward approximately ten degrees to bring the braking wheel 22 in contact with the skating surface 26, substantial variations in the inclination of slot 34 are possible, including the incorporation of means to allow adjustment of the amount of inclination of slot 34 to vary the initial braking force applied to wheel 22. Also, although in the preferred embodiment the axis of slot 34 is approximately aligned with the rotational axis of bearing 28, substantial variations in the orientation of bearing 28 in relation to slot 34 are possible, including the incorporation of means to allow adjustment of the orientation of the axis of slot 34 in relation to the rotational axis of bearing 28 for varying the maximum braking force. As is known and appreciated in the art, variations in the inclination of slot 34 and the orientation of the axis of slot 34 in relation to the rotational axis of bearing 28 will affect, and thus can be varied to control, the amount of braking force applied to wheel 22 for a given amount of weight applied over wheel 22 and a given inclination of skate 10 with respect to the skating surface 26.

23. Braking wheel 22 is preferably selected from a group of commercially available in-line skating wheels known in the art.

24. Referring to FIG. 3, wheel 22 is shown in contact with surface 26 but unloaded. Since bearing 28 does not act as a brake in the forward direction, wheel 22 can be biased against bearing 28 with shaft 32 in the lowest position in slot 34 to keep the shaft 32 from rattling. A common spring type wear adjuster may be installed in slot 34 to bias wheel 22 against clutch bearing 28, if necessary, to prevent such rattling.

25. FIG. 4 is a cross sectional view of the braking wheel assembly and the clutch bearing assembly shown in FIG. 3. Clutch bearing shaft 30 is preferably a hardened steel

shoulder bolt threaded into one side of frame 14 and tightened securely against thrust washer 36. When shaft 30 is threaded into the correct side of frame 14, clutch bearing 28 will torque the bolt 30 in the direction that tightens bolt 30 in the braking mode and will apply minimal torque in the other direction. Thrust washers 36 and 38 secure bearing 28 in the center of frame 14. Wheel 22 is rotatably mounted on shaft 32 by wheel bearings 68 and 70. Thrust washers 42 and 44 secure wheel 22 in the center of frame 14. Machine screw 46 is tightened into the end of shaft 32 to secure the shaft in frame 14.

26. FIG. 5 is a cross sectional view of a second embodiment with a slightly wider frame 52 in the front of the skate 10, which allows space for two braking wheels 54 and 56, and corresponding clutch bearings 58 and 60. The function and assembly of each of the preferably narrow brake wheels 54 and 56 are similar to brake wheel 22 of the first embodiment. Center thrust washer 62 spaces the braking wheels 54 and 56 apart and center thrust washer 64 spaces the clutch bearings 58 and 60 apart so that each clutch bearing can operate independently upon its associated brake wheel to resist rearward rotation solely of that brake wheel. Braking wheels 54 and 56 are rotatably mounted on shaft 66 by bearings 68 and 70, and clutch bearings 58 and 60 are rotatably mounted on shoulder bolt 72, which is securely threaded into frame 52. Shaft 66 is slidably secured in frame 52 through a slot 74 on both sides of frame 52.

27. This arrangement allows a spin to be accomplished by permitting one of the braking wheels 54 or 56 to roll freely forward on the skating surface 26, thus circling around the other braking wheel 54 or 56, which acts as a pivot point. The pivot braking wheel is restricted from rearward rolling by its associated clutch bearing, and thus the braking wheel 54 or 56 pivots about its contact point with the skating surface 26. In a clockwise spin the left braking wheel 56 rolls forward around the pivoting right braking wheel 54. Conversely, in a

counterclockwise spin the right braking wheel **54** rolls about the pivot point defined by the contact point of the left braking wheel **56** with the skating surface **26**.

28. FIG. 6 is a side view of a third embodiment of the invention and similar to the first embodiment except that it uses guide arms **82** and **83** pivotally mounted on each outside surface of frame **84** to allow translation of wheel **22** in an approximately vertical direction upwards near or against clutch bearing **28**, in place of the slotted holes **34** in the first embodiment. Guide arm **83** is not visible in FIG. 6, but may be identical in configuration to guide arm **82**. Arms **82** and **83** are pivotally mounted on axle **88** on the back end and rotatably mounted to wheel **22** through shaft **90** on the front end allowing wheel **22** to move in an approximately vertical direction toward brake assembly **24**. Alternatively, arms **82** and **83** could be pivotally mounted on pins protruding from frame **84** near axle **88** and provide the same function. Tabs **86** and **87** (not shown in FIG. 6) protrude from each side of frame **84** and position arms **82** and **83** and wheel **22** upwards near or against brake assembly **24**. Tab **87** is not visible in FIG. 6, but may be identical in configuration to tab **86**. The operation of skate **80** is essentially the same as skate **10** of the first embodiment.

29. Referring to FIG. 7, the approximately vertical translation of the braking wheel axle **90**, supported and guided by arms **82** and **83** (not shown in FIG. 7), is approximately in line the point of contact between the braking wheel **22** and the outer surface of clutch bearing **28** rotating about shaft **30** in frame **84**. This arrangement provides the same braking function as described for the first embodiment.

30. FIG. 8 is a cross sectional view of the components of FIG. 7 showing the arms **82** and **83** resting on the tabs **86** and **87** respectively, thus positioning unloaded braking wheel **22** upwards near or against clutch bearing **28**. Thrust washers **92** and **93** on the inside and

arms 82 and 83 on the outside secure wheel 22 on shaft 90 in the center of frame 84. In a loaded condition, that is with the skate 80 inclined forward, thus placing weight on braking wheel 22 such that braking wheel 22 is forced upwards fully engaging clutch bearing 28, arms 82 and 83 may be lifted above the resting position on tabs 86 and 87 respectively.

31. As is known and appreciated in the art, other embodiments with alternative means for securing braking wheel 22 upwards near or against clutch bearing 28 with the approximately vertical translational freedom of movement as provided by the slotted holes 34 in the first embodiment and by guide arms 82 and 83 in the third embodiment. For example, the approximately vertical translational freedom of movement can be provided by guide arms of material having sufficient flexibility fixedly mounted at the ends opposite the braking wheel 22 to each outside surface of frame 84 to allow translation of wheel 22 in an approximately vertical direction upwards near or against clutch bearing 28. Alternatively, the appropriate freedom of movement can be provided by mechanisms such as forks or other axle mounting devices that are slidably mounted in approximately vertically oriented cavities, channels or tracks. It can be appreciated that any such means allowing a modest range of approximately vertical translation of the braking wheel axle without imposing substantial frictional resistance would be suitable to permit braking wheel 22, under load, to be forced upwards fully engaging clutch bearing 28.

32. The detailed description set forth above in connection with the appended drawings is intended as a description of a presently preferred embodiment of the invention and is not intended to represent the only forms in which the present invention may be construction and/or utilized. The description sets forth the functions and the sequence of steps for constructing and operating the invention in connection with the illustrated embodiments. However, it is to be understood that the same or equivalent functions and sequence may be

accomplished by different embodiments that are also intended to be encompassed within the spirit and scope of the invention.

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